Table 2. Cost analysis

Description	Amount
Purchase price of the applicator (Tk)	5000
Working life of the applicator (5 years)	5
Capacity (ha/year, considering 20 working days per season)	60
Interest on investment, depreciation and others cost Tk./Yr.	2000
Working time (hr/year)	480
Wages of one labour (Tk/year)	15000
Total cost (Tk/year)	17000
Traditional cost in Tk to apply granule in 60ha	-
area (Considering 8 man-day per hectare	-
and Tk 250/man-day)	130000
Actual profit (Tk/ year)	113,000
Payback period, man-day	4
Benefit-cost ratio	6:1

Case study

Mr Alam Hossain son of Mr Abdul Jabber, village- Mothmalia, P O Baniakandi, upazila- Kumarkhali, district- Kushtia has been used BRRI USG applicator in his Aus, Aman and Boro rice field since 2009. He informed that by the advice of BRRI scientists he used 30 kg, 35 kg and 40 kg prilled urea in Aus, Aman and Boro season respectively in the plot area of 33 decimal each, whereas at the adjacent three plots of same size (33 decimal) each he used 16 kg, 17 kg and 24 kg USG. After harvest got similar rice yields in both the plot and he was able to save 14 kg, 18 kg and 16 kg urea in Aus, Aman and Boro season respectively for rice cultivation of one bigha area each. Therefore, USG applicator was economically profitable for him.

Urea saving

- Different amount of urea can be saved in different seasons on recommendations
- For Aus and Aman season, 1.8 g size granule is recommended whereas 2.7 g for Boro

Table 3. Saving percentage over prilled urea

Seasons	Prilled urea kg/ha	Granule urea kg/ha	Save Kg/ha	Recommended granule size (g)
Aman	165	115 (112*)	50	1.8
Boro	280	173 (168*)	107	2.7
Aus	125	115 (112*)	10	1.8

*Indicate the design requirement of granuler Urea.

Table 4. Nationally urea saving percentage (if 50% rice area replaced by USG)

Season	50% of the cultivated area, lac ha	Labour save/ha, man-day	Urea save/ha,kg	Total labour save over tradition practice, lac man-day	Total urea save over prilled urea, ton
Aus	5.635	7	10	39.45	56,35
Aman	26.85	7	50	187.95	134250
Boro	23.375	7	107	163.62	250112
Total	55.86	-	-	391.02	389,997

- 391.02 lac man-day equivalent 9775 million Tk (Tk 250/man-day)
- 389,997 ton urea equivalent around 8000 millionTk (Tk 20/kg urea)

Consideration during field operation

- Seedling should be transplanted in line maintaining line spacing 18 or 20 or 22 cm
- Two-third of the USG tank have to be filled by granules for smooth rotation of the metering device and avoid clogging during operation
- It should not operate in the field either in dry or more water logged condition

Limitations

- Applicator should be operated in the field with in 5-7 days after transplanting
- Standing water have to be maintained in the field from the date of transplanting till USG application
- Minimum standing water (0.5 cm) and muddy field is desirable for smooth operation
- Applicator should be operated by pushing force keeping the foot in the middle row and pulling would create blockage of USG dispensing in the field
- For maximum efficiency, applicator should be operated by steady and normal walking speed.

General features

- The applicator is suitable to place the USG in line transplanted rice field with line to line and plant to plant spacing 18 x 20 cm, 20 x 20 cm and 22 x 20 cm.
- Farmer can save seven man-days per hectare compared to manual placement
- Field capacity of the applicator : 32 decimal/h
- Weight of the applicator : 10 kg
- Average depth of USG placement : 6-8 cm
- Price of the machine : Tk 5000/-
- Required standing water during operation : 0.5 to 1cm
- Size of the USG tank : 0.15m x 0.015m (top), total height=0.18m, inclined plate L = 0.22 m and inclination 46 deg.

BRRI Enlisted Manufacturers for USG Applicator:

1. **The Metal (pvt.) Limited**
   PBL Tower (14th Floor), 17 North C/A, Gulsion Circle-2
   Dhaka-1212, Phone: 02-8835006
2. **Alim Industries Ltd.**
   BSCIC Industrial Estate, Kadamtali, Sylhet-3100, Ph: +88 0821 840664
3. **Alam Engineering Works**
   42/4 Bhajohori Shaha Street
   Warri, Dhaka-1100, Mobile Ph. +8801711 356055
4. **Bhai Bhai Engineering Works**
   Shampur Bazar, Purbadhala, Netrakona
   Mobile Ph. +8801713 547748

For more information

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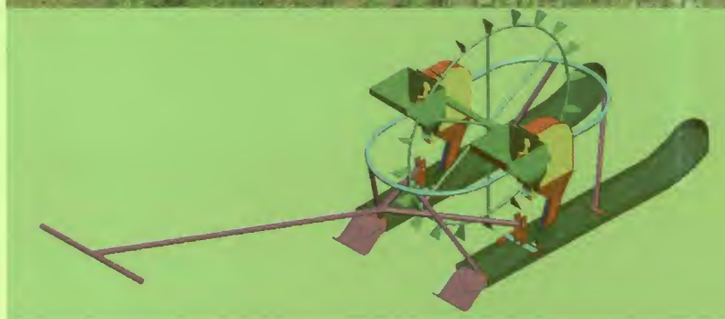
BRRI USG Applicator

For Saving Urea & Profitability



By

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Introduction

The farmers of Bangladesh usually use prilled urea (PU) for rice production. To improve fertilizer use efficiency, different types of fertilizer materials and application techniques are becoming available day by day. Urea super granule (USG) is one of the nitrogenous fertilizer that is now available in the country and farmers are using it for rice cultivation. It was found that USG is more effective than PU in terms of efficiency in wetland rice cultivation. The loss of N by leaching, runoff with water, nitrification, de-nitrification, amonification and volatilization is minimal in USG and it is efficient to supply more N to crops compare to PU. Therefore, USG application may be a good option to save nitrogen fertilizer as a result to minimize production cost as well as to increase yield. The placement of USG at 6- 8 cm depth in rice field could increase nitrogen use efficiency by 40% to 70%. However, it is more laborious and time consuming to place and cover USG at proper depth manually. Considering the problem of USG application in rice field, a push-type manually operated USG applicator was developed at Bangladesh Rice Research Institute (BRRI).

Description

BRRI developed USG applicator is a push-type manually operated machine and it can be operated by one labour easily. The USG can be placed in two rows simultaneously and by single pass four rows are covered. Cup-type metering device is used to collect USG from tank and dispense to the output channel. The drive wheel diameter is 63.69 cm considering the 200 cm periphery of the drive wheel. Five cups are assembled into the metering plate. As a result, five granules collected from tank and dispense in 200 cm distance with one rotation of the metering device that make 40 cm spacing between each placement. Skids of the applicator were applied to operate the machine in wetland condition. The length and width of the skid was critically selected 72 and 12 cm respectively for smooth operation in the muddy field. Furrow opener of the applicator was connected at the bottom of the skid maintaining 26 degree sliding angle. Height (6 cm) and length (12 cm) of the sliding side of the furrow opener was designed in such a way that the granules dispensed easily to the field without clogging and protecting muddy soil from incursion into the opener. Output channel of the applicator was connected with granule tanks and furrow opener that conveyed the collected granules to the field. The lower part of the channel was connected on skid with a rectangular holder at 20 degree inclined. The covering plate, assembled at the backside of the skid, works additionally as weeding tools. Depth of the covering device from horizontal line of the skid was maintained 4.5 cm, which is less than the depth of USG placement into the soil.

There is a jointer to control the height of the handle. As a result, operator of different height can operate the applicator.

Field operation

The applicator have to setup in the field in such a way that the drive wheel and skids remain in line properly and move easily. Two-third of the tank was filled with granule. During field operation, minimum standing water (0.5-1.0cm) should be maintained for smooth operation. However, standing water should be maintained in the field till the date of USG application for maintaining the softness of the field that will help to make furrow opening and closing properly. Adjustment of the handle height is important for efficient operation in the field. It varies with operator height. Handle height have to be adjusted in such a way that the covering device remain in contact with the soil horizontally. It is always operated by pushing. If it is pulled back during operation, the dispensed channel becomes blocked by muddy soil that restricts the placeed of granule and remains in the output channel.

There are three options to adjust the spacing of the applicator considering the line to line distance of the transplanted rice. Two nuts of the main axle, four nuts of the frame and two nuts of the handle have to be adjusted among the three options of 18 cm, 20 cm or 22 cm considering the existing line spacing of the transplanted rice before field operation. It should be remembered that the machine has to operate in the field through the middle row maintaining the forward motion to avoid the clogging of the outlet by muddy soil.

Field capacity

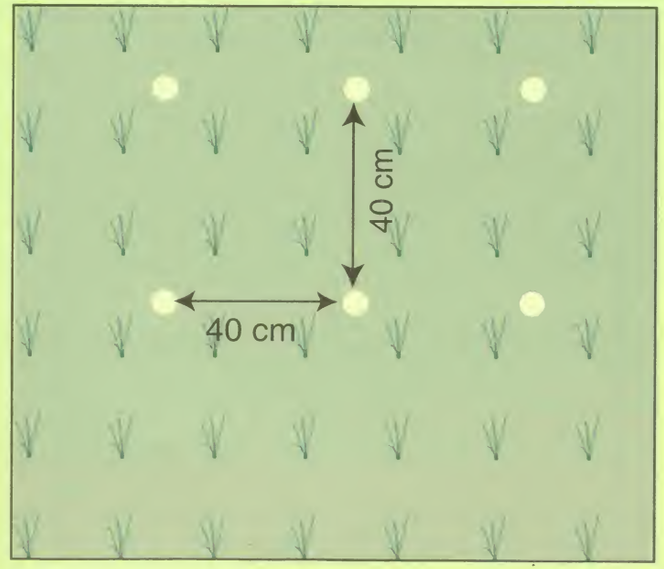
Capacity of the applicator depends on the walking speed, land condition, soil type, operator strength and skill, uniformity of granule, bonding free and strength of the granule. The field capacity of the applicator was measured in the BRRI research field and 12 different locations of the country during Aman and Boro seasons 2009, 2010 and 2011. Modified BRRI USG applicator was also operated in BRRI research plot to observe the performance and compare with the traditional placement method of USG. Field capacity of the modified version compared with the previous version of the applicator. During field operation, average walking speed of the operator was found 1.95 km/h and 1.85 km/h for adjustable and fixed type applicator respectively. Field capacity were about 32.5 decimal/h and 31.8 decimal/h for adjustable and fixed type applicator respectively, whereas manual USG application capacity was found 4.5 decimal/h only. Average depth of granules placement were 5-6cm for the applicator and 4-5cm for manual placing (Table 1) . So, it is possible to save 7 man-day/ha using the applicator.

Table1. Field performance of the applicator

Item	Adjustable type	Fixed type	Traditional application
Time of applicaltion1, min	43	41	133
Area covered, decimal	25	25	10
Walking speed, km/h	1.95	1.85	-
Field capacity, decimal/h	32.5	31.8	4.5
Depth of placement, cm	5-6	5-6	4-5
Weight of dispensed USG, kg/ha	165	168	165

Time of operation is the total time including turning, USG filling, machine setting and other losses.

The depth of USG placement was found 6.6 cm. The distance between granules and depth of placement also varied with the depth of penetration of the applicator in the field. Considering the 2.7g size of granules (recommended for Boro), the calculated amount of fertilizer is 168 kg/ha. In field trials, around 173 kg/ha granules were dispensed in the field. Considering 280 kg/ha recommended dose of prilled urea, it is possible to save 107 kg urea per ha in Boro season. Using the applicator, farmers will be able to save seven man-day/ha as compared to the traditional method of USG application. At the same time, 50 and 10 kg urea/ha can be saved as compared to the prilled urea in rice production during Aman and Aus seasons respectively.



Seedling placement and USG application system